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Adhesions are the major cause of complications in operative gynecology

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Adhesion formation has been found to be highly prevalent in patients with a history of operations or inflammatory peritoneal processes. These patients are at a high risk of serious intraoperative complications during a subsequent operation if adhesiolysis is performed. These complications include bowel perforation, ureteral or bladder injury, and vascular injury. In order to minimize the risk of these complications, adhesiolysis should only be performed by experienced surgeons, and intraoperative strategies must be adopted. The reduction of the overall incidence of adhesions is essential for subsequent surgical treatments. Anti-adhesion strategies must be adopted for preventing the reoccurrence of adhesions after abdominopelvic operations. The strategies employed to reduce the risk and the overall incidence of adhesions have been elucidated in this article.

Introduction

In abdominopelvic surgery, the term ‘adhesions’ refers to the connective tissue strands between anatomic structures that are normally not attached to each other. The extent of adhesions can vary from single adhesions with less or no clinical symptoms to adhesions of the whole abdomen and/or pelvis that especially develop after extended previous operations or infections and can be the cause of a variety of intra- and postoperative complications.

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Many studies have revealed important insights into the pathogenesis of adhesions, although the diverse influences on adhesion development are still not fully understood. It is well known that the basis of adhesion development is an imbalance between fibrin deposition and fibrinolysis. Fibrin is deposited at a surgical site in a normal response to a surgical trauma. However, factors such as tissue hypoxia or an increased inflammatory reaction contribute to a cytokine environment that hinders the lysis of the deposited fibrin through an interaction between the cytokines and the components of the fibrinolytic system. As a consequence, the fibrin clot is not degraded after a few days (as usual). The following invasion of fibroblasts and other cells causes a reorganization of the clot to a stable strand of connective tissue that may contain vessels and nerves [1–3].

Because of the complex influences on adhesion development, it can neither be predicted with a sufficient degree of certainty which patients develop adhesions after an operation nor in which patients adhesions are present before an operation. Data about the incidence of adhesions considerably differ depending on the regarded study which makes a general statement about the improbability of the incidence. However, in most of the studies, the incidence varies between 20% and 93% [4–8]. These significant variations may be explained by diverse operation and entry techniques as well as by different underlying diseases. The presence of adhesions is more probable in patients with a history of laparotomy or extended operation. However, patients are likely to develop adhesions after laparoscopic surgery, as the latter can reduce the risk of adhesion development but cannot prevent it completely [5]. Furthermore, it is known that some operations such as myomectomy, endometriosis surgery, ovarian and tubal surgery as well as adhesiolysis are high-risk procedures concerning adhesion development and reformation of adhesions irrespective of whether they are performed laparoscopically or by laparotomy [9](REF34, cave search for original REF!). Even a 20% incidence of adhesion development, and therefore the presence of adhesions in one-fifth of the patients, is alarming and should be the reason for every surgeon to be familiar with strategies to avoid complications during an operation in patients with existing adhesions and also to avoid adhesion in general.

Intraoperative complications through adhesions and approaches to avoid them

In daily routine, every abdominopelvic surgeon is confronted with patients who have adhesions, wherein these can be the cause of the patients' discomfort, for example, in the case of chronic pelvic pain [10–12], infertility [13–16], or bowel obstruction [17], or are found coincidentally while performing an operation for another underlying disease. In both situations, an adhesiolysis must be performed, in the first case to solve the clinical problem and in the second to restore the normal anatomy to make the operation of the underlying disease successful. Adhesiolysis, however, is associated with a high risk of intraoperative complications such as inadvertent bowel, bladder, ureter, and vessel injury. But before performing adhesiolysis, the first critical step, that is, access to the abdominal cavity, carries a significant risk of organ injury due to adhesions. Particularly in the case of laparotomies by a longitudinal incision in the anamnesis, the presence of adhesions in the area of the previous incision in the abdominal wall must be considered (Fig. 1). In a minimally invasive surgery, such as laparoscopy, the presence of umbilical adhesions is of special interest as the insertion of the trocar can lead to organ injury, especially injury of the bowel, due to the adhesions that attach the organs to the abdominal wall (Fig. 2). In a study of 814 patients, umbilical adhesions were found in 0.68% of patients with no previous abdominal surgery (group 1; $n = 469$), 1.6% with prior laparoscopic surgery (group 2; $n = 125$), 19.8% with previous laparotomy with a horizontal suprapubic incision (group 3; $n = 131$) and 51.7% with a previous laparotomy with a midline incision. Although the presence of severe adhesions in the bowel was much less compared with the overall incidence of umbilical adhesions in the single groups, a high number of patients with previous laparotomy were at a potential risk of bowel injury if the umbilical trocar was inserted blindly (group 1: 0.42%, group 2: 0.80%, group 3: 6.87%, and group 4: 31.46%) [18]. Another study investigated the presence of umbilical adhesions in patients with a history of laparoscopy through an umbilical incision. Patients with a history of other surgeries were excluded. Of the 151 patients studied, 32 (21.2%) had umbilical adhesions and 4 (2.6%) bowel adhesions. As a